Markus Berndt, Ph.D.

Applied Mathematician

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Education

5/1999	Ph.D. in Applied Mathematics, University of Colorado at Boulder, Dept. of Applied Mathematics. Thesis title: Adaptive refinement and the treatment of singularities in first-order system least squares (FOSLS). Advisor: Prof. Stephen F. McCormick.
5/1996	M.S. in Applied Mathematics, University of Colorado at Boulder, Dept. of Applied Mathematics.
6/1994	Diplom-Mathematiker, Heinrich-Heine-Universität Düsseldorf, Germany, Lehrstuhl für Angewandte Mathematik. Advisor: Prof. Kristian Witsch.

Leadership Experience

9/2015 – present	Deputy Group Leader, Computational & Statistical Sciences Division, CCS-2: Computational Physics and Methods Group, Los Alamos National Laboratory.
3/2015 – 6/2015	Acting Focus Area Lead for Consortium for Advanced Simulation of Light Water Reactors (CASL) Thermal Hydraulics Methods (THM).
10/2014 – 2/2015	Acting Deputy Group Leader, Computational & Statistical Sciences Division, CCS-2: Computational Physics and Methods Group, Los Alamos National Laboratory.
10/2014 – 11/2014	Acting Focus Area Lead for CASL-THM, while M. Christon was on medical leave.
Since 4/2014	Code Project Lead for CCS-2's Hydra code team.
1/1988 – 9/1988	Squad Leader in a Signal Battalion of the West-German Army.

Professional Profile

Expertise	Scientific Parallel Computing, Numerical Analysis of PDEs, Linear and Nonlinear Solvers, Numerical Linear Algebra, Arbitrary Lagrangian Eulerian Methods, Mesh Improvement Methods, Mesh Generation.

Projects (current and former)	CASL's Thermal Hydraulics Focus Area, Lagrangian Applications Project (LAP), Setup Project, Advanced Simulation Capability for Environmental Management (ASCEM), LDRD-DR: Predicting Climate Impacts and Feedbacks in the Terrestrial Arctic, Telluride Project, ASCI Solvers Project

Employment

9/2015 – present	Deputy Group Leader, Computer, Computational & Statistical Sciences Division, CCS-2: Computational Physics and Methods Group, Los Alamos National Laboratory.
3/2015 – 9/2015	Scientist, Computer, Computational & Statistical Sciences Division, CCS-2: Computational Physics and Methods Group, Los Alamos National Laboratory.
10/2014 – 2/2015	Acting Deputy Group Leader, Computer, Computational & Statistical Sciences Division, CCS-2: Computational Physics and Methods Group, Los Alamos National Laboratory.
10/2009 – 9/2014	Scientist, Computer, Computational & Statistical Sciences Division, CCS-2: Computational Physics and Methods Group, Los Alamos National Laboratory.
10/2008 – 10/2009	Scientist, Theoretical Division, T-5: Applied Mathematics and Plasma Physics Group, Los Alamos National Laboratory.
12/2005 – 9/2008	Technical Staff Member, Theoretical Division, T-7: Mathematical Modeling and Analysis Group, Los Alamos National Laboratory.
12/2000 – 12/2005	Limited Term Staff Member, Theoretical Division, T-7: Mathematical Modeling and Analysis Group, Los Alamos National Laboratory.
6/1999 – 12/2000	Postdoctoral Research Associate, Advisor: Joel Dendy, Theoretical Division, T-7: Mathematical Modeling and Analysis Group, Los Alamos National Laboratory.
1994, '95 and '96 (summers)	Graduate Research Assistant, Advisor: Daniel Quinlan, Scientific Computing Group, CIC-19, Los Alamos National Laboratory.
9/1994 – 5/1999	Graduate Research Assistant, Advisors: Stephen F. McCormick and Thomas A. Manteuffel, Department of Applied Mathematics, University of Colorado at Boulder.
7/1987 – 9/1988	Soldier, Compulsory Military Service, West-German Army, Germany.

Publications

[1] R. V. Garimella, W. A. Perkins, M. W. Buksas, M. Berndt, K. Lipnikov, E. Coon, J. D. Moulton, S. L. Painter, "Mesh Infrastructure for Coupled Multiprocess Geophysical Simulations", *Procedia Engineering*, 82 (2014):34âĂŞ45.

[2] R. V. Garimella, J. Kim, and M. Berndt, "Polyhedral Mesh Generation for Non-manifold Domains", Proceedings of the 22nd International Meshing Roundtable, Springer International Publishing, (2014):313–330.

[3] M. T. Calef, E. D. Fichtl, J. S. Warsa, M. Berndt, and N. N. Carlson, "Nonlinear Krylov acceleration applied to a discrete ordinates formulation of the k-eigenvalue problem," *J. Comput. Phys.* 238 (2013):188-209.

[4] M. Berndt, J. Breil, S. Galera, M. Kucharik, P.-H. Maire, and M. Shashkov, "Two-Step Hybrid Conservative Remapping for Multimaterial Arbitrary Lagrangian-Eulerian Methods," *J. Comput. Phys.* 230, issue 17 (2011): 6664-6687.

[5] M. Kucharik, J. Breil, S. Galera, P.-H. Maire, M. Berndt, and M. Shashkov, "Hybrid Remap for Multi-Material ALE," *Comput. Fluids* 46, issue 1 (2011): 293-297.

[6] M. Berndt, M. Kucharik, and M. J. Shashkov, "Using the feasible set method for rezoning in ALE," *Procedia Comp. Sci.* 1, issue 1 (2010): 1879-1886.

[7] D. Bailey, M. Berndt, M. Kucharik, and M. Shashkov, "Reduced-Dissipation Remapping of Velocity in Staggered Arbitrary Lagrangian-Eulerian Methods," *J. Comput. Appl. Math.* 233 (2010): 3148-3156.

[8] M. Berndt, G. Hansen, and J. D. Moulton "Efficient Nonlinear Solvers for Laplace-Beltrami Smoothing of Three-Dimensional Unstructured Grids," *Comput. Math. Appl.* 55 (2008): 2791-2806.

[9] P. Vachal, M. Berndt, K. Lipnikov, and M. Shashkov, "A Node Reconnection Algorithm for Mimetic Finite Difference Discretizations of Elliptic Equations on Triangular Meshes," *Commun. Math. Sci.* 3, no. 4 (2005): 665-680.

[10] M. Berndt, K. Lipnikov, M. Shashkov, M. F. Wheeler, and I. Yotov, "Superconvergence of the velocity in mimetic finite difference methods on quadrilaterals," *SIAM J. Numer. Anal.* 43, issue 4 (2005): 1728-1749.

[11] M. Berndt, K. Lipnikov, M. Shashkov, M. F. Wheeler, and I. Yotov, "A Mortar Mimetic Finite Difference Method on Non-Matching Grids," *Numer. Math.* 102, issue 2 (2005): 203-230.

[12] M. Berndt, T. A. Manteuffel, and S. F. McCormick, "Analysis of First-Order System Least Squares (FOSLS) for Elliptic Problems with Discontinuous Coefficients: Part II," *SIAM J. Numer. Anal.* 43, issue 1 (2005): 409-436.

[13] M. Berndt, T. A. Manteuffel, S. F. McCormick, and G. Starke, "Analysis of First-Order System Least Squares (FOSLS) for Elliptic Problems with Discontinuous Coefficients: Part I," *SIAM J. Numer. Anal.* 43, issue 1 (2005): 386-408.

[14] M. Berndt and M. Shashkov, "Multilevel Accelerated Optimization for Problems in Grid Generation," Proceedings of the 12th International Meshing Roundtable, Santa Fe, NM, 2003.

[15] M. Berndt, K. Lipnikov, J. D. Moulton, and M. Shashkov, "Convergence of mimetic finite difference discretizations," *East-West J. Numer. Math.* 9, issue 4 (2001): 265-284.

[16] M. Berndt, "Adaptive refinement and the treatment of discontinuous coefficients for multilevel first-order system least squares (FOSLS)," (Ph.D. diss., University of Colorado at Boulder, 1999).

[17] M. Berndt, T. A. Manteuffel, and S. F. McCormick, "Local error estimates and adaptive refinement for first-order system least squares (FOSLS)," *ETNA* 6 (1997): 35-43.

Technical Reports and Articles in Conference Proceedings

[1] J. Bakosi, M. Berndt, M. A. Christon, R. Sankaran, "Hydra-TH Linear Algebra Improvements and Performance Optimization", CASL L3 Milestone Report, LA-UR 14-27391, 2014.

[2] J. Kim, R. V. Garimella, and M. Berndt, "A Practical Approach for Solving Mesh Optimization Problems using NewtonâĂŹs Method.", Research Notes, 22nd International Meshing Roundtable, Springer-Verlag 2013.

[3] J. D. Moulton, J. Meza, M. W. Buksas, M. Berndt, L. A. Pritchett-Sheats, et al., "High-Level Design of Amanzi, the Multi-Process High Performance Computing Simulator", Tech. Rep. LA-UR-12-22193, 2012.

[4] R. H. Dylan, E. M. Kwicklis, A. V. Wolfsberg, J. D. Moulton, K. N. Lipnikov, C. W. Gable, N. M. Becker, M. Berndt, and V. V. Vesselinov, "ASCEM Pumping Test Capabilities: Benchmarking and Demonstration for UGTA at U–20 WW," Los Alamos National Laboratory, Tech. Rep. LA-UR-12-26614, 2012.

[5] T. Gianakon, M. Bement, M. Berndt, J. S. Brock, T. R. Canfield, T. C. Carney, J. L. Collins, J. Fung, A. K. Harrison, P. J. Henning, M. A. Kenamond, J. M. Reynolds, T. Aida, M. J. Shashkov, B. M. Smith, and R. C. Ward, "Detailed report from LAP for L1 2012 PCF Milestone on Initial Condition for Boost I. (U)", Tech. Rep. LA-CP-12-827, 2012.

[6] M. Berndt and T. Niday, "Code Performance Improvements in Mesh Relaxation (U)", in Level Two LAP Milestone, Tech. Rep. LA-CP-11-644, 2011.

[7] N. N. Carlson and M. Berndt, "Application of PEDERNAL to a problem of coupled heat and oxygen transport in U02 nuclear fuel.", Tech. Rep. LA-UR-09-06311, 2009.

[8] T. Austin, M. Berndt, and J. D. Moulton, "A memory efficient parallel tridiagonal solver," Los Alamos National Laboratory, Tech. Rep. LA-UR-03-4149, 2003.

[9] D. L. Brown, D. J. Quinlan, G. S. Chesshire, W. D. Henshaw, and M. Berndt, "Adaptive composite overlapping mesh algorithms on message passing architectures", Los Alamos National Laboratory, Tech. Rep. LA-UR-97-2169, 2009.

[10] D. Quinlan and M. Berndt, "MLB: Multilevel load balancing for structured grid applications," Proceedings of the SIAM Parallel Conference, Minneapolis, MN, March 1997.

[11] M. Berndt and K. Witsch, "Multigrid on overlapping patches," Proceedings of the Seventh Copper Mountain Conference on Multigrid Methods, vol. CP 3339, NASA, Hampton, VA, 1996, pp. 31-40.

Conference Presentations

[1] "Accelerating Mesh Relaxation with the Nonlinear Krylov Accelerator (NKA) (U)," at NECDC 2012, Livermore, CA.

[2] "Using Polynomial Filtering for Rezoning in ALE, at Conference on Numerical methods for multi-material fluid flows," September 2011, Arcachon, France.

[3] "Using the feasible set method for rezoning in ALE," at International Conference on Computational Science, May 2010, Amsterdam, The Netherlands

[4] "A Robust Mesh Untangling and Smoothing Method for ALE," SIAM Computational Science & Engineering, March 2009, Miami, FL.

[5] "A robust ALE rezone strategy that is capable of mesh untangling (U)," NECDC 2008, Livermore, CA.

[6] "A Fast Geometric Mesh Untangling Algorithm for ALE Methods," SIAM Annual Meeting, July 2008, San Diego, CA.

[7] "A Node Reconnection Algorithm for Mimetic Finite Difference Discretizations of Elliptic Equations on Triangular Meshes," at 2007 SIAM Conference on Mathematical and Computational Issues in the Geosciences, Santa Fe, NM.

[8] "A Preconditioned Condition Number Based Mesh Relaxer for 2D Dendritic/AMR Meshes with Very Bad Aspect Ratios," Conference on Numerical methods for multi-material fluid flows, Prague, Czech Republic, September 2007.

[9] "An Efficient Nonlinear Solver for a Mesh Smoothing Problem," LACSI Symposium, October 11, 2005.

[10] "Toward an Efficient Nonlinear Solver for a Mesh Smoothing Problem," Copper Mountain Conference on Multigird Methods, Apr. 2005.

[11] "Mesh Reconnection Method for the Solution of Elliptic Problems," SIAM Conference on Computational Science & Engineering, Orlando, FL, Feb. 2005.

[12] "Parameter estimation via risk-based optimization," SIAM Annual Meeting, Portland, OR, July 2004.

[13] "Line and Plane Relaxation in parallel BoxMG," Copper Mountain Conference on Iterative Methods, Copper Mountain, CO, March 2004.

[14] "Parameter estimation via risk-based optimization," Los Alamos Computer Science Institute Symposium, 2003.

[15] "Multilevel accelerated optimization for problems in grid generation," 7th US Congress on Computational Mechanics in Albuquerque, 2003.

[16] "Multilevel accelerated optimization for problems in grid generation," Copper Mountain Conference on Multigrid Methods, 2003.

[17] "Multilevel accelerated optimization for unstructured meshes," Los Alamos Computer Science Institute Symposium, 2002.

[18] "Small Linux Cluster Workshop:Installing MPI and Running Parallel Code," at ASME International Mechanical Engineering Congress and Exposition, 2001.

[19] "Small Linux Cluster Workshop: Installing MPI and Running Parallel Code," SIAM Annual Conference, San Diego, 2001.

[20] "On a multilevel solver that utilizes singular basis functions for the solution of the diffusion equation with discontinuous coefficient," at 2000 Copper Mountain Conference on Iterative Methods, Copper Mountain, CO.

[21] "On a multilevel solver for the flux based first-order system least squares formulation of the diffusion equation with discontinuous coefficient," at 2000 Arizona Days, Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, NM.

[22] "Toward Multigrid for L2 FOSLS for the Diffusion Equation with Discontinuous coefficients and Singular Basis Functions," at 1999 Copper Mountain Conference on Multigrid Methods, Copper Mountain, CO.

[23] "First-Order System Least Squares for Elliptic Problems with Discontinuous Coefficients," at 1998 Copper Mountain Conference on Iterative Methods, Copper Mountain, CO.

[24] "Adaptive Mesh Refinement for Fist-Order System Least Squares," at 1997 Copper Mountain Conference on Multigrid Methods, Copper Mountain, CO.

[25] "Multigrid on Overlapping Patches," at 1995 Copper Mountain Conference on Multigrid Methods, Copper Mountain, CO.

Mentoring

8/2002 – 8/2004	Travis Austin was my postdoc for two years. I mentored him while he conducted research on parallel structured multigrid, and contributed to the Telluride project. Travis is now a Senior Manager at MSC Software.
2007, '08 (summers)	Christian Ketelsen was my summer student for two consecutive summers. I mentored him in his work on parallel structured multigrid. Chris is now an Instructor at University of Colorado Boulder.

Activities

2003 – 2007	Co-organizer of LANL's T-7 summer student program.

2004	Panelist for an NSF review panel.
1/2000	Co-organizer of Arizona Days at the Center for Nonlinear Studies at Los Alamos National Laboratory.
Since 2000	Reviewer for SIAM Journal of Numerical Analysis, SIAM Journal of Scientific Computing, E.T.N.A, IEEE, IMA Journal of Numerical Analysis, Journal of Computational Physics, Numerical Linear Algebra with Applications.

Awards

12/2012	Los Alamos National Laboratory Large Team Distinguished Performance Award, for LAP/B61 Working Groups For Improvement on the B61 ASC Implosion Baseline (U)
8/2004	LAAP Teamwork Award, (members of the T-7 Highlight Book team)
6/2004	LAAP Teamwork Award (together with T. Austin, J. Dendy, and D. Moulton)

Professional Collaborations

since 2010	Pierre-Henri Maire, Jerome Breil and Stephane Galera, Universite Bordeaux, France
since 2008	Milan Kucharik, Czech Technical University in Prague, Czech Republic.
1999 – 2005	Stephen F. McCormick and Thomas A. Manteuffel, both at University Colorado at Boulder.
2003 – 2005	Mary F. Wheeler, at University of Texas at Austin.
2003 – 2005	Ivan Yotov, at University of Pittsburgh